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Distobactrodesmium gen. nov. to accommodate *Bactrodesmium rahmii* and notes on *Bactrodesmium*

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Abstract—A new genus *Distobactrodesmium* is proposed to accommodate *Bactrodesmium rahmii*, characterized by sporodochial conidiomata that produce distoseptate, brown to dark brown phragmoconidia through monoblastic conidiogenous cells. Notes and illustrations on *Bactrodesmium* species are provided.

Key words—asexual fungi, hyphomycetes, taxonomy

Introduction

Bactrodesmium Cooke is typified by *B. abruptum* (Berk. & Broome) E.W. Mason & S. Hughes, as designated by Hughes (1958). Réblová & al. (2020) provided an emended description and revision of *Bactrodesmium*, supported by phylogenetic analysis of the combined ITS, SSU, LSU, rpb2, and tef1-α sequences. The genus is distinguished by sporodochial, punctiform, pulvinate, scattered, brown to black conidiomata composed of (semi-)

macronematous, mononematous, cylindrical (sometimes moniliform), fasciculate or compact aggregated, brown conidiophores. The conidiogenous cells are monoblastic, rarely terminal, determinate, sometimes elongating sympodially, and subhyaline to hyaline. Conidial secession is rhexolytic, and conidia are solitary, acrogenous, variously shaped (globose, subglobose, clavate, pyriform, ellipsoidal, obovoid, fusiform or cylindrical), transversely euseptate (sometimes with a longitudinal or oblique septum), smooth or verruculose, and olivaceous brown or black (Réblová & al. 2020). Réblová & al. (2020) excluded *B. gabretae* Koukol & Kolářová and *B. rahmii* from the genus due to the presence of distoseptate conidia. They accommodated *B. gabretae* in a new genus as *Aphanodesmium gabretae* (Koukol & Kolářová) Réblová & Hern.-Restr., but Réblová & al. (2020) did not propose any taxonomic change for *B. rahmii*, despite its distance from the *Bactrodesmium* generic concept. Therefore, we propose the new genus *Distobactrodesmium* to accommodate this atypical *Bactrodesmium* species.

Taxonomy

Distobactrodesmium Z.F. Niu, K. Zhang & R.F. Castañeda, **gen. nov.**

IF 557439

Differs from *Bactrodesmium* by its distoseptate phragmoconidia.

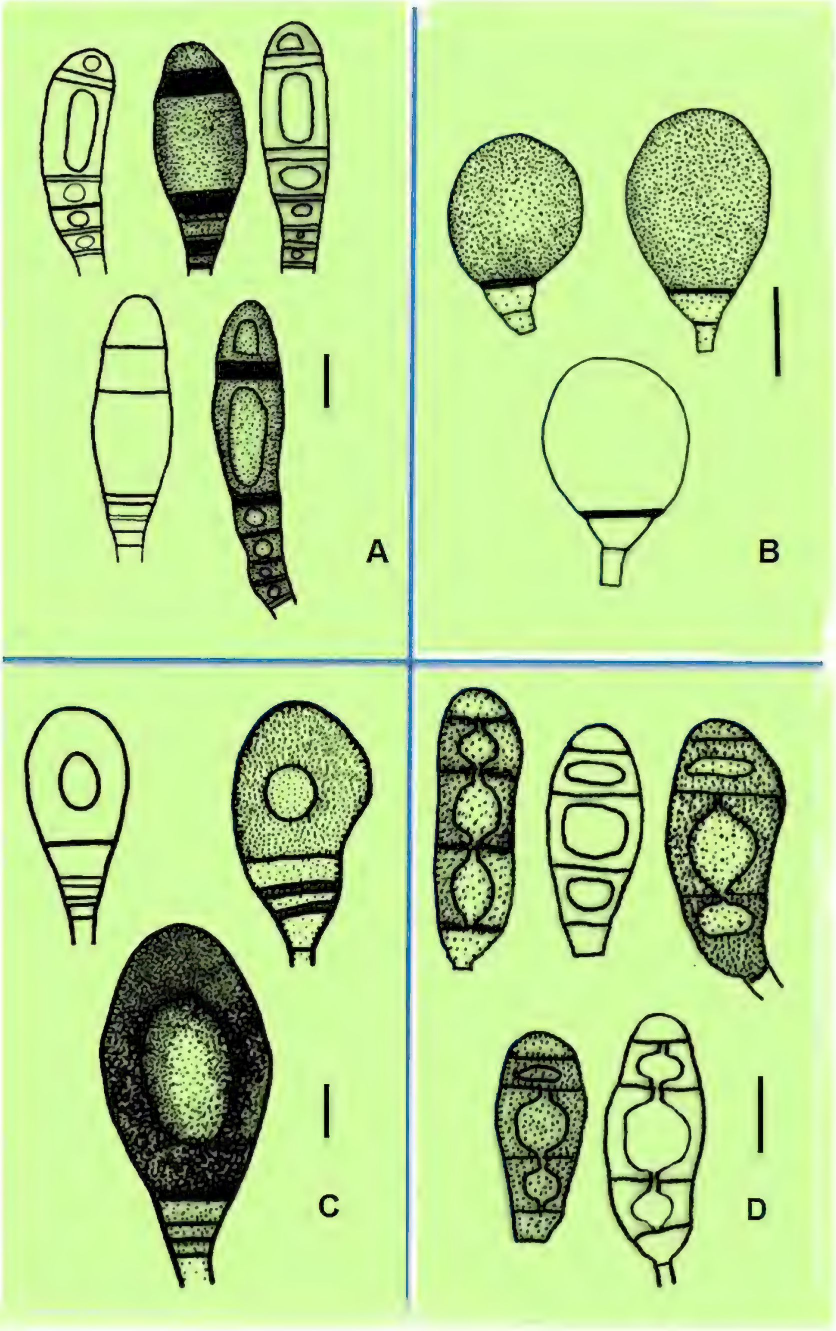
Type species: *Bactrodesmium rahmii* M.B. Ellis [≡ *Distobactrodesmium rahmii* (M.B. Ellis) Z.F. Niu & al.]

Etymology: Latin, *Disto*-, referring to the distoseptate conidia, and -*bactrodesmium*, referring to the genus *Bactrodesmium*.

Conidiomata on natural substrates sporodochial, scattered, pulvinate or irregular, brown to reddish-brown or black. Mycelium superficial and immersed. Stromata rudimentary, textura angularis or globose sometimes present. Conidiophores macronematous, mononematous, unbranched or with short lateral branches, cylindrical, erect, septate, smooth-walled, hyaline or subhyaline. Conidiogenous cells monoblastic, integrated or discrete, cylindrical or slightly clavate (sometimes inflated near the conidiogenous loci), determinate (rarely indeterminate with sympodial extensions), hyaline or subhyaline. Conidial secession rhexolytic. Conidia solitary, acrogenous (sometimes acropleurogenous), obovoid to clavate, distoseptate, sometimes with thin oblique or longitudinal septa, smooth,

Continued on p. 150

Fig. 1. *Bactrodesmium* conidia (re-drawn from the literature). A. *B. abruptum* (Ellis 1959); B. *B. aquaticum* (Borse & al. 2019); C. *B. atrum* (Ellis 1959); *B. betulicola* (Ellis 1959). Scale bars = 10 μm.


A
B
C
D

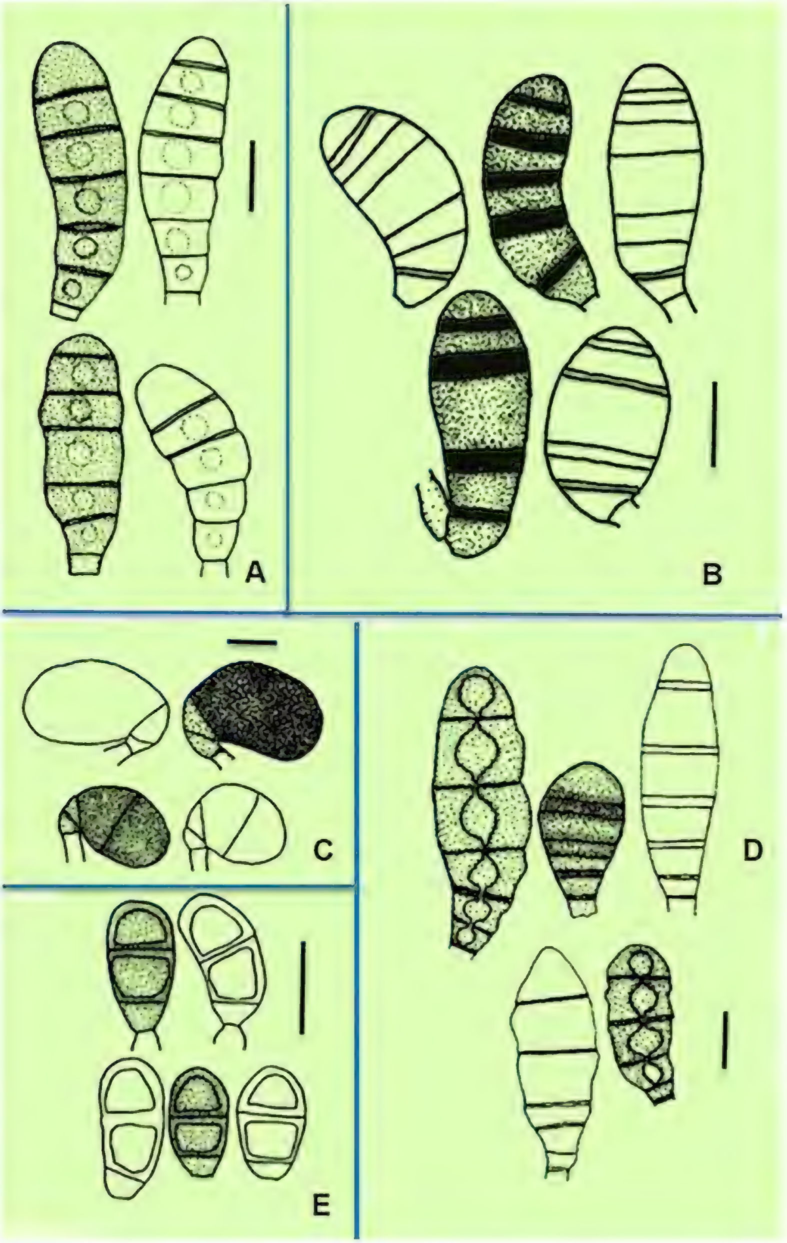


Fig. 2. *Bactrodesmium* conidia (re-drawn from the literature). A. *B. biformatum* (Hughes 1983); B. *B. cedricola* (Ellis 1959); C. *B. curvatum* (Kirk 1985); D. *B. diversum* (Hernández-Restrepo & al. 2013); E. *B. esheri* (Kirk 1983). Scale bars = 10 µm.

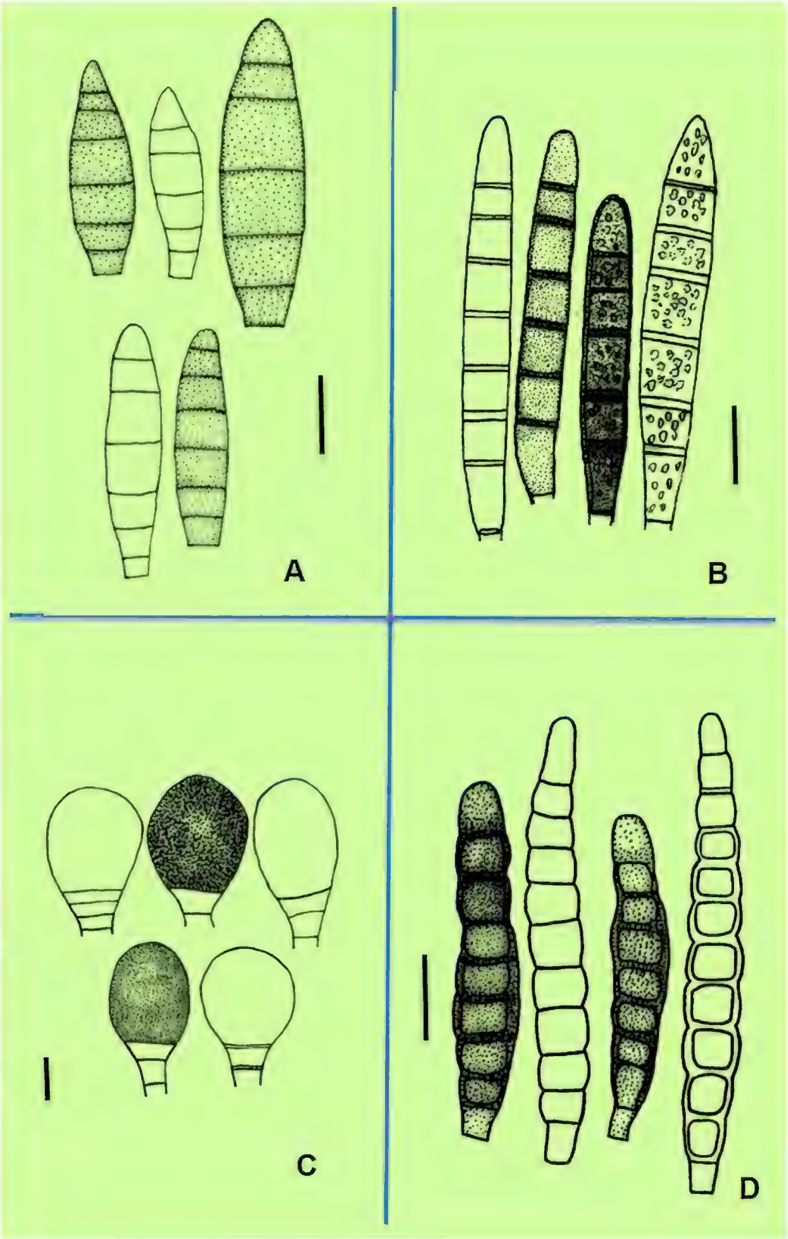


FIG. 3. *Bactrodesmium* conidia (re-drawn from the literature). A. *B. ellipsoideum* (Rao 1983); B. *B. fruticosum* (Matsushima 1993); C. *B. globosum* (Holubová-Jechová 1972); D. *B. guamense* (Matsushima 1981). Scale bars = 10 µm.

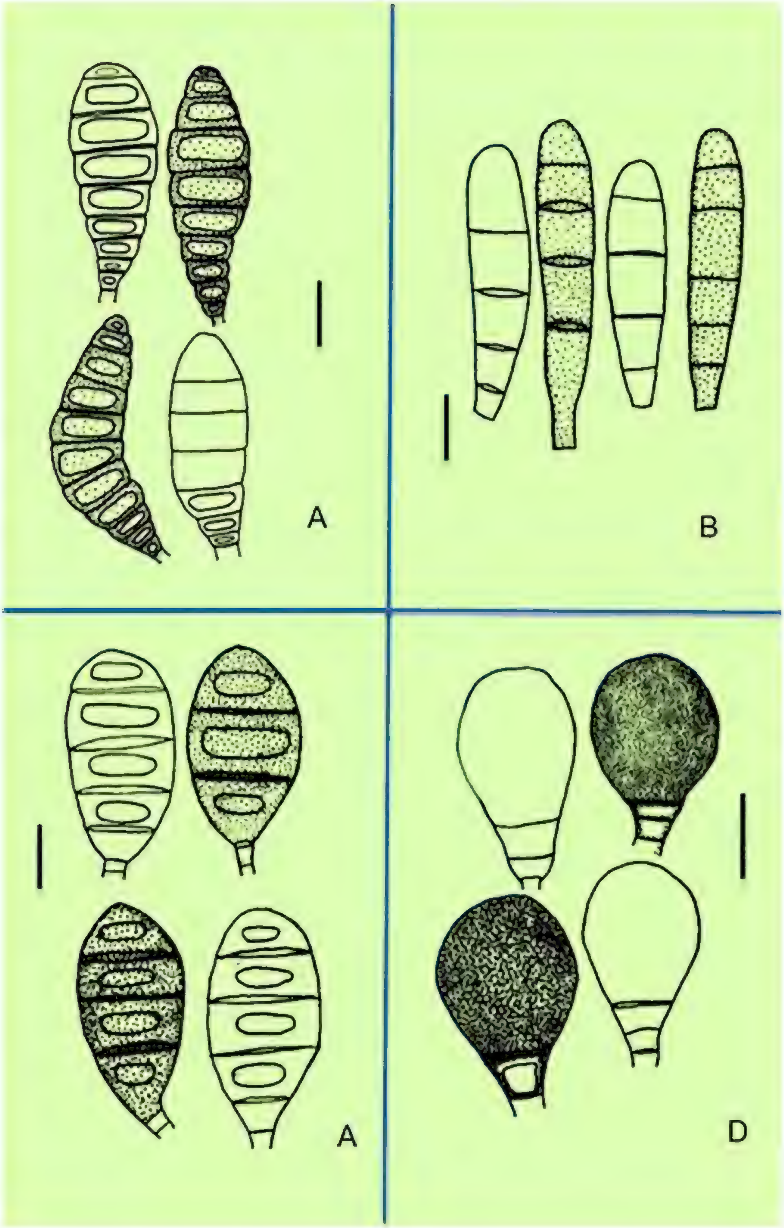


FIG. 4. *Bactrodesmium* conidia (re-drawn from the literature). A. *B. hebridense* (Kirk 1986); B. *B. indicum* (Rao 1983); C. *B. leptopus* (Saccardo 1881); D. *B. linderi* (Palm & Stewart 1982). Scale bars = 10 µm.

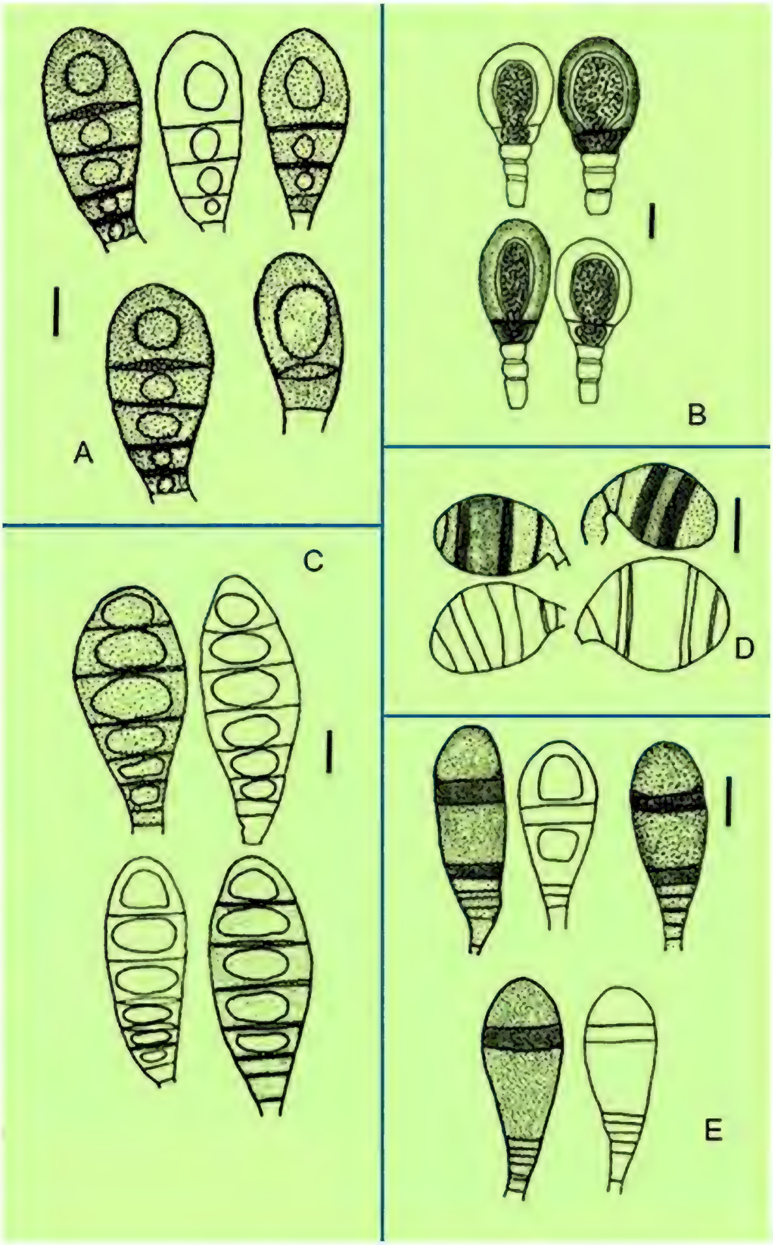


FIG. 5. *Bactrodesmium* conidia (re-drawn from the literature). A. *B. moenitum* (Palm & Stewart 1982); B. *B. mucosum* (Matsushima & Matsushima 1995); C. *B. nothofagi* (Cooper 2005); D. *B. obliquum* (Sutton 1967); E. *B. obovatum* (Ellis 1959). Scale bars = 10 µm.

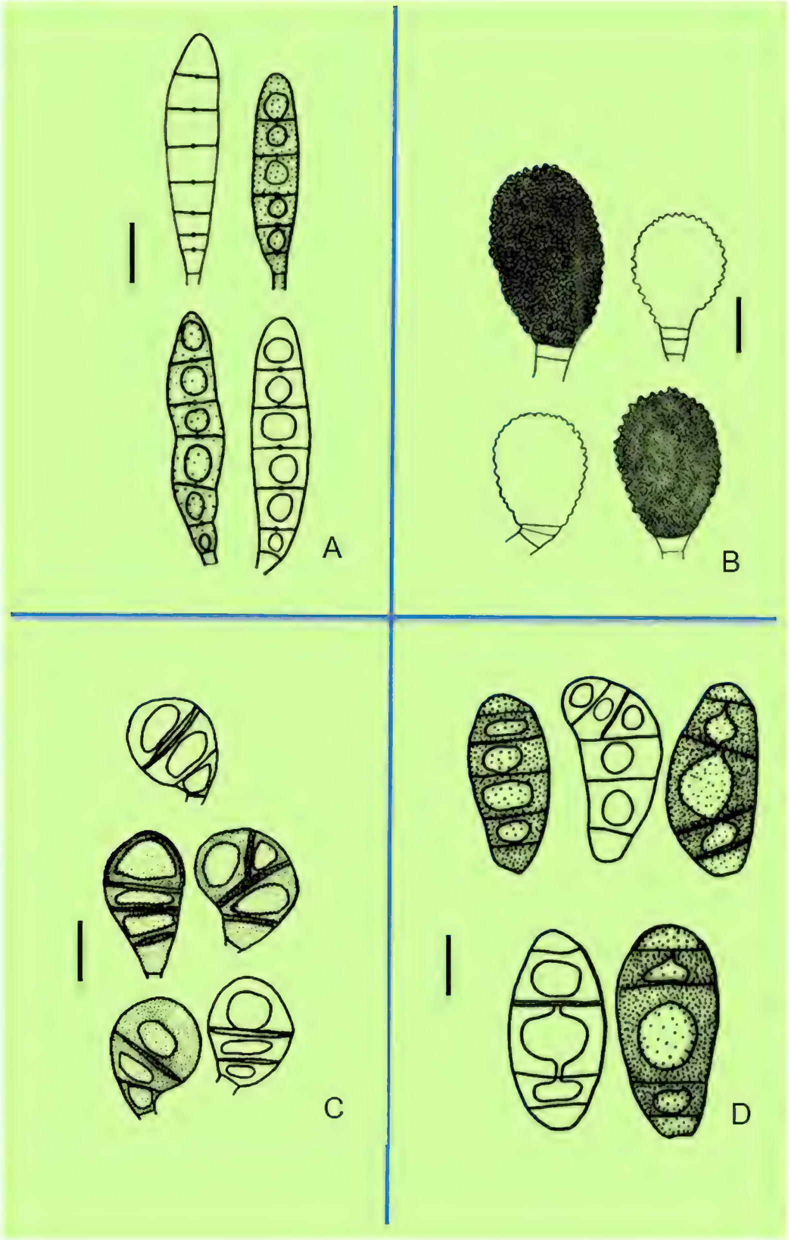


FIG. 6. *Bactrodesmium* conidia (re-drawn from the literature). A. *B. pallidum* (Ellis 1959); B. *B. palmicola* (Mercado Sierra & al. 1995); C. *B. peruvianum* (Sutton 1977); D. *B. pithoideum* (Sutton 1975). Scale bars = 10 µm.

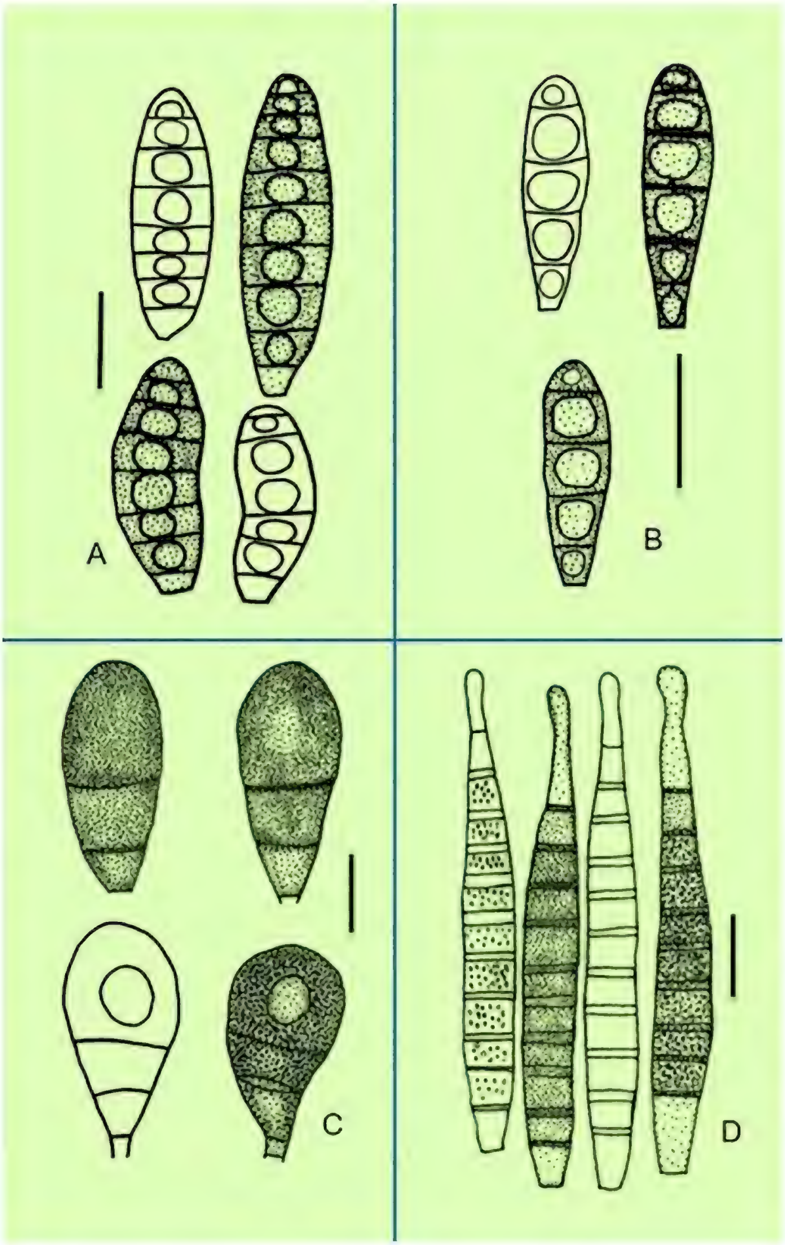


FIG. 7. *Bactrodesmium* conidia (re-drawn from the literature). A. *B. pluriseptatum* (Révay 1993); B. *B. pusillum* (Markovskaja 2006); C. *B. pyriforme* (Holubová-Jechová 1972); D. *B. ramosius* (Matsushima 1993). Scale bars = 10 µm.

brown to dark brown, with one or two hyaline or subhyaline cells toward the fimbriate base.

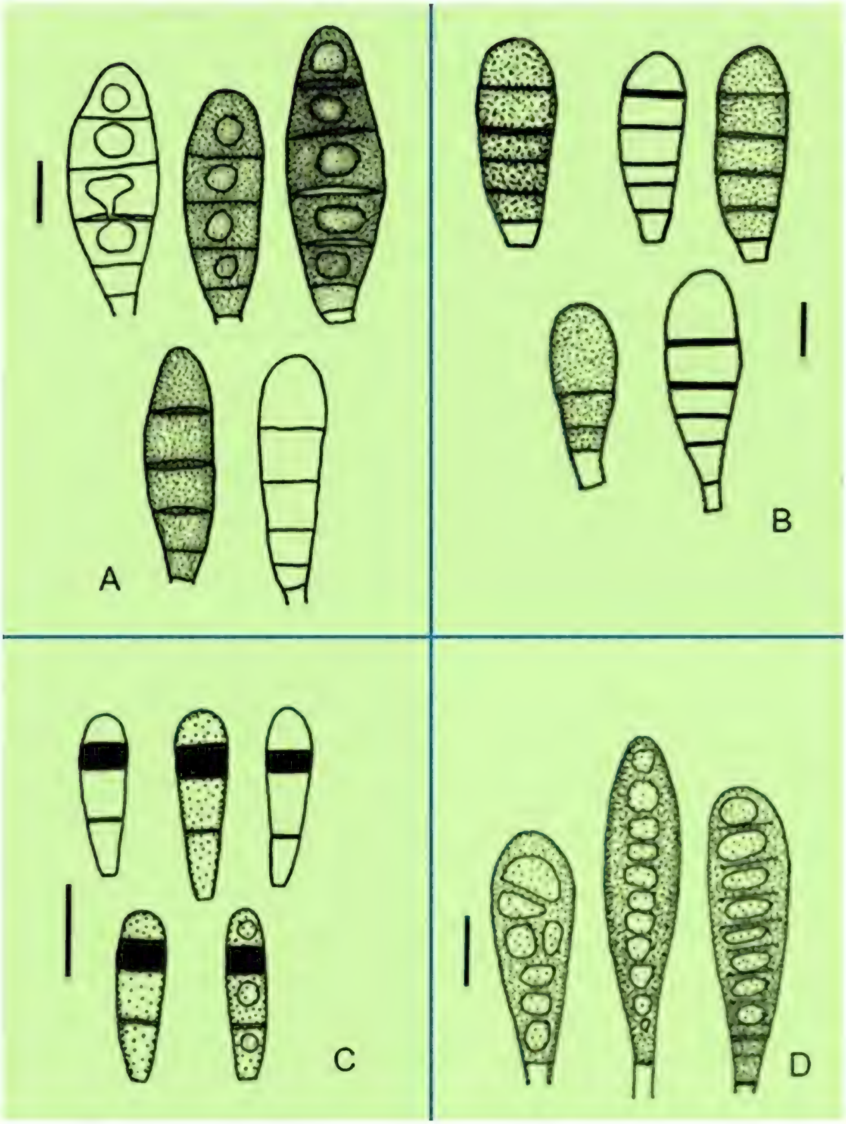


Fig. 8. *Bactrodesmium* and *Distobactrodesmium* conidia (re-drawn from the literature). A. *B. spilomeum* (Hughes & White 1983b); B. *B. traversoanum* (Ellis 1959); C. *B. xerophilum* (Borowska 1975); D. *D. rahmii* (Ellis 1976). Scale bars = 10 µm.

Distobactrodesmium rahmii (M.B. Ellis) Z.F. Niu, K. Zhang & R.F. Castañeda, **comb. nov.** Fig. 8D

IF 557440

≡ *Bactrodesmium rahmii* M.B. Ellis, More Demat. Hyphomyc.: 68 (1976).

Distobactrodesmium rahmii differs from all accepted *Bactrodesmium* species (Figs 1–10, Table 1) by its distoseptate conidia, as noted by Hughes & White (1983d) and Réblová & al. (2020). The conidia have cells with a much reduced lumen and a particular septation sequence (Hughes & White 1983d). This species has been recorded as an endophytic fungus associated with *Ziziphus* sp. (*Rhamnaceae*) in Oman (El-Nagerabi & al. (2013) and has also been found on decaying leaf litter of *Hevea brasiliensis* (Willd. ex A. Juss) Müll. Arg. (*Euphorbiaceae*) in Thailand (Seephueak & al. 2010) and on bark and dead branches of *Picea* sp. (*Pinaceae*) in Canada and Switzerland (Ellis 1976, Hughes & White 1983d).

Discussion

Conidial ontogeny and conidiogenous events have been considered fundamental criteria for asexual fungal taxonomy and generic delimitation (Kendrick 2017, Seifert & al. 2011). Following their multigene DNA analyses, Réblová & al. (2020) accommodated four atypical *Bactrodesmium* species within three new genera: *Aphanodesmium* (for *A. gabretae*) and *Kaseifertia* Réblová & al. (for *K. cubense* (R.F. Castañeda & G.R.W. Arnold) Réblová & al.), both genera characterized by rhexolytic conidial secession, and *Gamsomyces* Hern.-Restr. & Réblová (for *G. longisporus* (M.B. Ellis) Hern.-Restr. & Réblová (type) and *G. stilboideus* (R.F. Castañeda & G.R.W. Arnold) Hern.-Restr. & Réblová), characterized by schizolytic conidial secession. Several *Bactrodesmium* species (Figs 1–10, Table 1) have been described and illustrated with a truncate conidial base produced after schizolytic conidial secession: e.g., *B. betulicola* M.B. Ellis, *B. moenitum* (J.L. Crane & Shearer) M.E. Palm & E.L. Stewart, *B. nothofagi* J.A. Cooper, *B. pithoideum* (Dearn. & House) B. Sutton, *B. pluriseptatum* Révay, and *B. pusillum* Markovsk. (Ellis 1959, Sutton 1975, Palm & Stewart 1982, Révay 1993, Cooper 2005, Markovskaja 2006). Despite their apparent schizolytic secession, these species still remain in *Bactrodesmium* (Réblová & al. 2020). Additional morphological and molecular studies will probably result in the segregation of other species into new genera

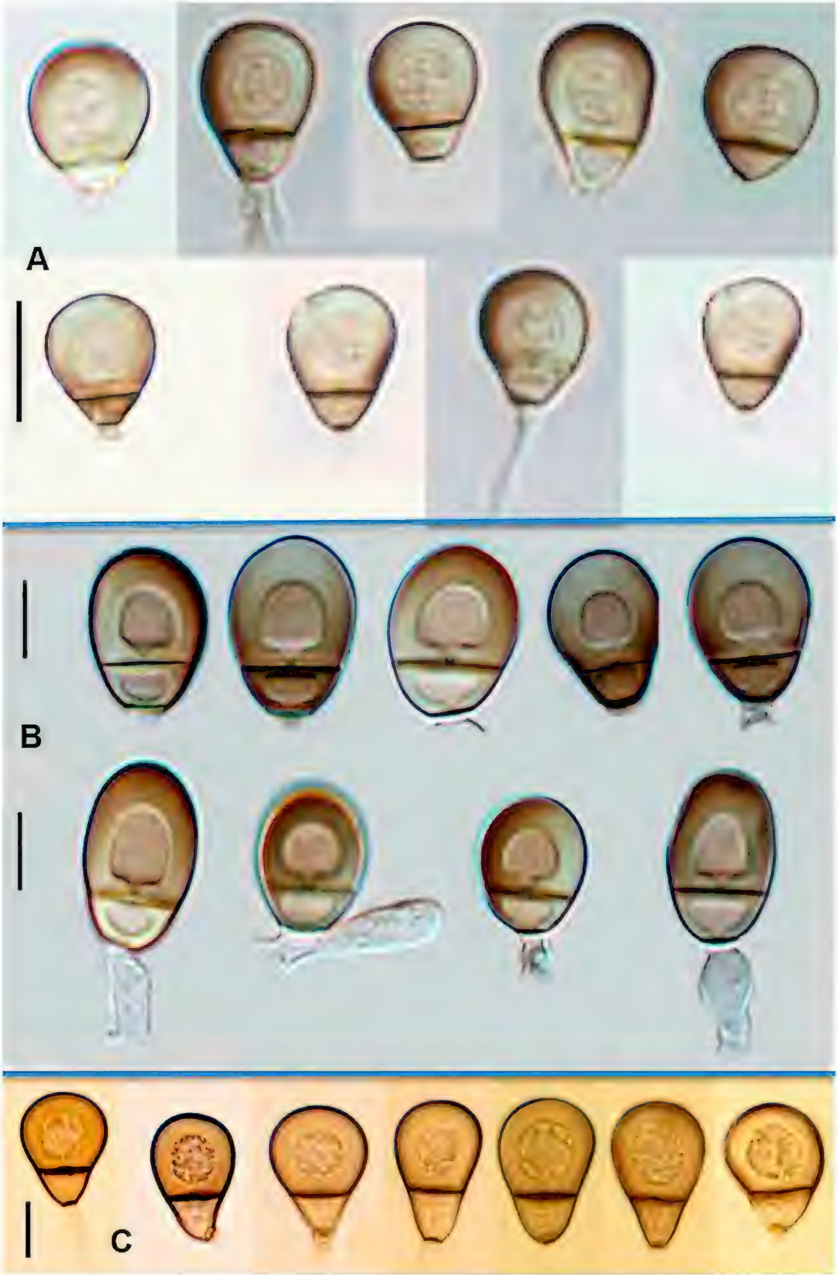


Fig. 9. *Bactrodesmium* conidia. A. *B. novageronense* (Espinoza & al. 2020). B. *B. pulcherrimum*. (Espinoza & al. 2020). C. *B. simile* (Arias & al. 2016). Scale bars = 10 µm.

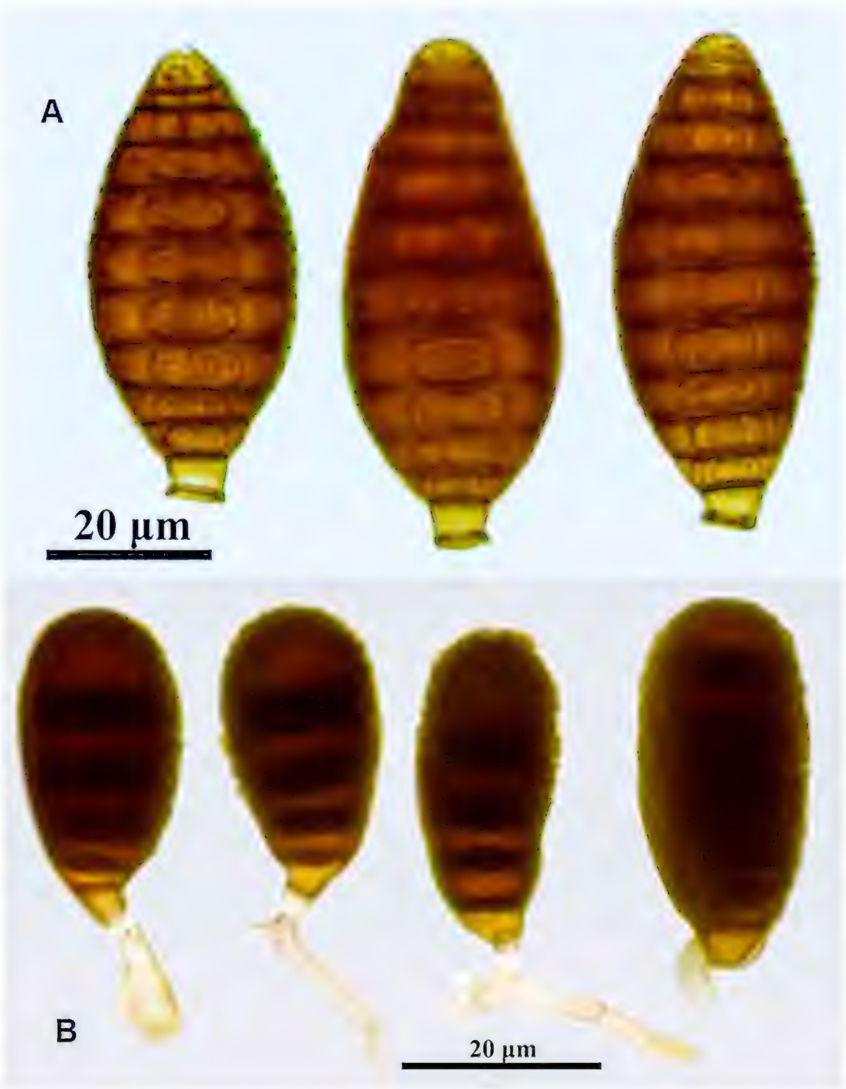


Fig. 10. *Bactrodesmium* conidia.
A. *B. chinense* (Shi & al. 2020). B. *B. lushanense* (Shi & al. 2020).

TABLE 1. Comparative conidial morphology of accepted *Bactrodesmium* species and *Distobactrodesmium rahmii*.

SPECIES	SHAPE	SEPTA	CONIDIAL SIZE (µm)	FIG.	REFERENCE
B. abruptum	Clavate to oblong-clavate	3–7	32–70 × 12–17	1A	Ellis 1959
B. aquaticum	Broadly pyriform	2	15–26 × 10–18	1B	Borse & al. 2019
B. atrum	Obovoid	3–5	43–72 × 22–38	1C	Ellis 1959
B. betulicola	Ellipsoidal or cylindrical	4	26–40 × 9–15	1D	Ellis 1959
B. biformatum	Ellipsoidal to clavate	(3–)5–7 (-9)	23–40 × 7–9	2A	Hughes 1983
B. cedricola	Ellipsoidal, cylindrical or clavate	1–6	20–35 × 9–18	2B	Ellis 1959
B. chinense	Ellipsoidal to broadly fusiform or navicular	(9–)10 (–11)	54–63.5 × 23.5–26.5	10A	Shi & al. 2020
B. curvatum	Subglobose to broadly pyriform	3	24–32 × 14–20	2C	Kirk 1985
B. diversum	Ellipsoidal or clavate, sometimes obovoid, pyriform or sigmoid	2–5	18–64 × 10–18	2D	Hernández-Restrepo & al. 2013
B. ellipsoideum	Broad ellipsoidal to fusiform or navicular	5–6	30–42 × 9–12	3A	Rao 1983
B. esheri	Ellipsoidal to obovoid	2	10.5–15 × 5.5–7.5	2E	Kirk 1983
*B. fruticosum**	Cylindrical	(2–)4–6 (-8)	30–55 × 5–6.5	3B	Matsushima 1993
B. globosum	Obovoid or broadly clavate	2–3	30–47.5 × 20–24	3C	Holubová-Jechová 1972
*B. guamense**	Cylindrical-fusiform or cylindrical-clavate	3–13	20–62.5 × 5.5–8	3D	Matsushima 1981
B. hebridense	Ellipsoidal	8–11	36–54 × 11–15	4A	Kirk 1986
B. indicum	Clavate to cylindrical	4–5	35–52 × 7–11	4B	Rao 1983

Species	Shape	Septa	Conidial size (µm)	Fig.	Reference
B. leptopus	Clavate, ellipsoidal or broadly obovoid	3-5	21–44 × 11.5–15.5	4C	Saccardo 1881
B. linderi	Pyriform to broadly pyriform to globose	(0-)1-2 (-3)	15-28 × 11-18	4D	Palm & Stewart 1982
B. lushanense	Obovoid, clavate or ellipsoidal	(3–)5(–6)	25.5–41.5 × 14–18.5	10B	Shi & al. 2020
B. moenitum	Obovoid to pyriform	3-4	28-48 × 9-31	5A	Palm & Stewart 1982
*B. mucosum**	Broadly clavate	3-5	35-60 × 20-30	5B	Matsushima & Matsushima 1995
B. nothofagi	Obovoid to pyriform	5–8	47–55 × 18–25	5C	Cooper 2005
B. novageronense	Obovoid to subglobose	1	8–13 × 7–10	9A	Castañeda-Ruiz 1985 Espinoza & al. 2020
B. obliquum	Ovoid	4-transverse, 0–3 oblique	23–33.5 × 16–21.5	5D	Sutton 1967
*B. obovatum***	Clavate	4–5	28–58 × 15–23	5E	Ellis 1959, Ellis 1963, Hughes & White 1983a
B. pallidum	Cylindrical, ellipsoidal or clavate	5–6	35–55 × 9–12	6A	Ellis 1959
B. palmicola	Obovoid, clavate or ellipsoidal	3–4	22–44 × 15–22	6B	Mercado Sierra & al. 1995
B. peruvianum	Pyriform to obovoid	2–3-transverse 1-oblique	14–20 × 11.5–13.5	6C	Sutton 1977
B. pithoideum	Obovoid to sub-reniform	4	22.5–29.5 × 11.5–14.5	6D	Sutton 1975
B. pluriseptatum	Ellipsoidal or cylindrical	6–9	30–44 × 11–14	7A	Révay 1993
B. pulcherrimum	Broadly obovoid to subnapiform	1	18–24 × 13–19	9B	Espinoza & al. 2020
B. pusillum	Elongated ellipsoidal to clavate	(4–)5 (–6)	18–25 × 6.5–7.5	7B	Markovskaja 2006
B. pyriforme	Obovoid to pyriform	2	26–30 × 12.5–16	7C	Holubová-Jechová 1972
B. ramosius	Narrow fusiform	8–12	40–64 × 5–7	7D	Matsushima 1993

Species	Shape	Septa	Conidial size (µm)	Fig.	Reference
B. simile	Broadly pyriform to obovoid	1	19–24 × 12–16	9C	Arias & al. 2016
B. spilomeum	Obovoid or clavate to narrowly ellipsoidal	(3–)4–5 (–6)	25–49 × 9–16	8A	Hughes & White 1983b
B. traversoanum	Ellipsoidal or clavate	3–6	20–37 × 8–12	8B	Ellis 1959 Hughes & White 1983c
B. xerophilum	Cylindrical, ellipsoidal or obovoid	2	14–26 × 3.5–7.5	8C	Borowska 1975
D. rahmii	Obovoid to clavate	4–10-distoseptate	32–58 × 13–18	8D	Ellis 1976

* Morphological data from culture; **as "*Bactrodesmium arnaudii*"

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